Section 2 - Overview

This section provides an introductory technical description of the OEC Workstation. It is organized as follows:

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References

Refer to Workstation Interconnect Diagram 00-878981 as you read this section.

Major Functions

The OEC Workstation provides most of the user interfaces and all of the external data interfaces in an OEC mobile digital imaging system. It also performs the system's computing and image manipulation functions such as post processing and storage. The Workstation also provides AC power conversion, distribution, and monitoring, directs many automated functions, and reports system conditions to the operator to ensure safe and accurate system operation.

Physically, the Workstation consists of two high-resolution video monitors mounted on a moveable cart equipped with a keyboard and other user interfaces. The AC line cord that powers the Workstation and image generator enters the rear of the Workstation, as does the system interconnect cable that carries power to, receives video from, and exchanges data with the X-Ray generator. The Workstation contains many electronic assemblies, and can be equipped with optional devices such as a VCR or dye diffusion printer.

When the Workstation connects to an X-Ray generator, it can capture and process live fluoroscopic images. It can also be used as a standalone device for viewing and postprocessing stored images.

A typical Workstation appears on the following page.

WorkStation Components

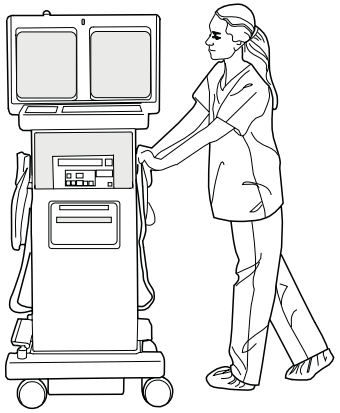
Major Components

Major internal Workstation components include the Host Controller, Display Subsystem, Cine Disk Subsystem, Image Subsystem, User Interface, External Interface, and Power Distribution Subsystem.

The following paragraphs first describe the mechanical characteristics of the Workstation, and then discuss each of the major components.

Mechanical Details

The basic Workstation without any optional equipment weighs about 400 pounds (182 kg) and stands about 64 inches (163 cm) high. Its wheelbase is about 27.5 by 27.5 inches (70 by 70 cm). One person can safely move the Workstation over level flooring or carpet.

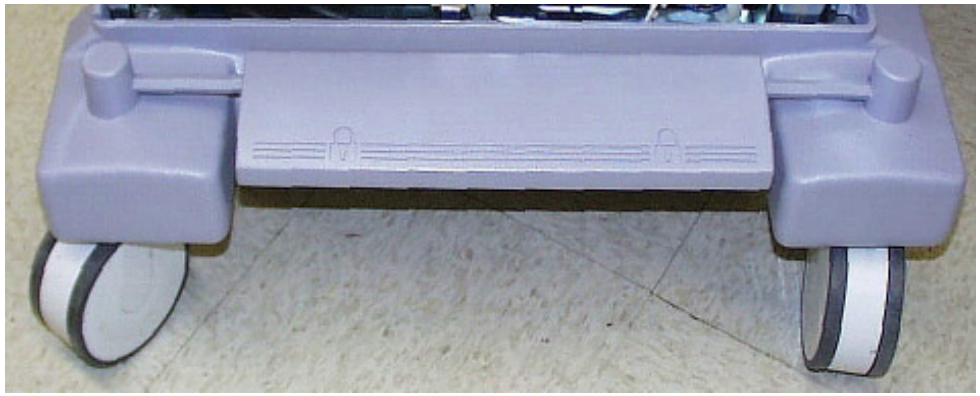


Workstation is Safe and Easy to Move

Locking the Workstation Casters

The Workstation brake pedal has three positions:

1. The **UP** position locks two of the four Workstation casters facing straight ahead, making it easier to push the Workstation longer distances, such as down a hallway.
2. The **CENTER** pedal position permits all casters to pivot freely so you can maneuver the Workstation around corners and obstacles. Use this pedal position when placing the Workstation in its final operating location.



Brake Pedal

Workstation Moving Precautions

WARNING: *Never move the Workstation up or down an incline of greater than 10 degrees. It may roll out of control.*

WARNING: *Get another person to help you when moving the Workstation up or down an incline. It may roll out of control.*

WARNING: *Never attempt to move the Workstation up or down steps. Personal injury or equipment damage may otherwise result.*

WARNING: *Never lock the Workstation in place on an incline. It may tip over.*

CAUTION: *Move the Workstation separately from other imaging system equipment.*

CAUTION: *Be careful of people and obstructions when moving the Workstation. Even low-speed collisions can result in significant personal injury and equipment damage.*

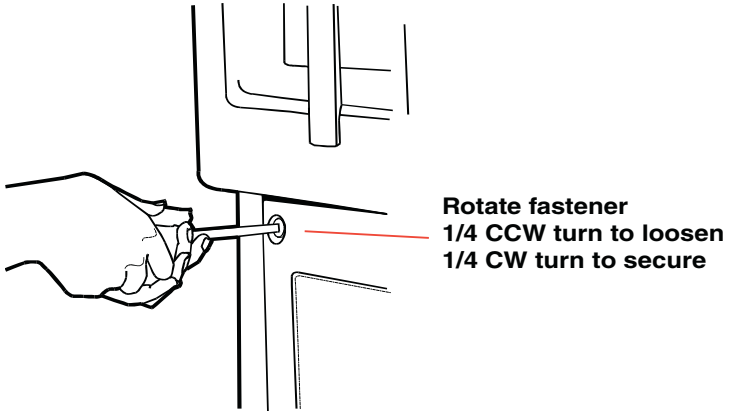
Cover Removal

WARNING: *Removing any Workstation cover exposes dangerous electrical voltages on several components. When possible, disconnect Workstation from AC line before removing any covers. When it is necessary to leave the power applied, use extreme care to avoid death or injury from electrical shock.*

Note: *Set the brake before attempting to remove Workstation covers.*

The Workstation's rear, side, and front covers are removable, as is the monitor cover. However, you must first remove the rear cover before you can remove the side or front covers. You can remove the monitor cover at any time.

Eight quarter-turn fasteners hold the rear cover in place. You must loosen all eight fasteners before you can remove the rear cover.

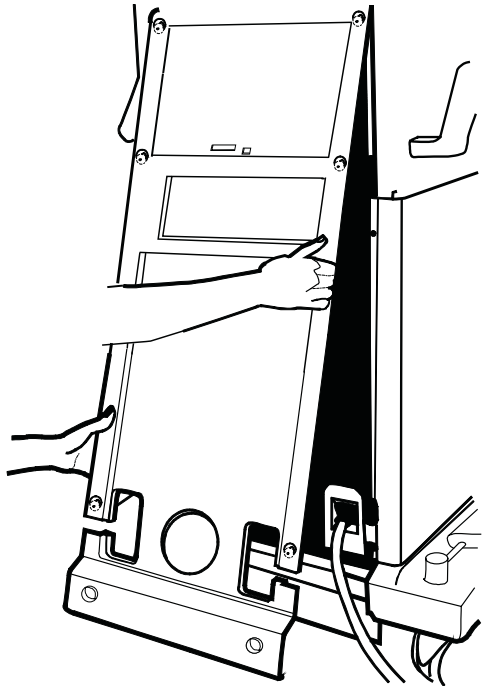


Quarter-Turn Fasteners

Rear Cover Removal

Follow these steps to remove the rear cover:

1. Loosen eight quarter-turn fasteners that secure rear cover to Workstation chassis.
2. Move the bottom of rear cover outward a few inches, and then pull cover downward and outward.



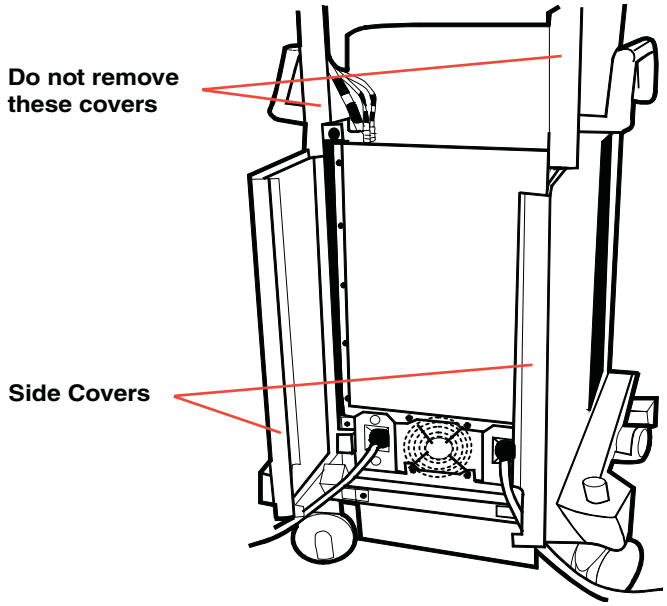
Rear Cover Removal

Side Cover Removal

***Note**: Rear cover must be removed before side covers or front cover can be removed*

***Note**: Left and right side covers fit into slots in Workstation base and under handles on either side of Workstation.*

Remove both side covers by pulling each of them to the rear of the Workstation.

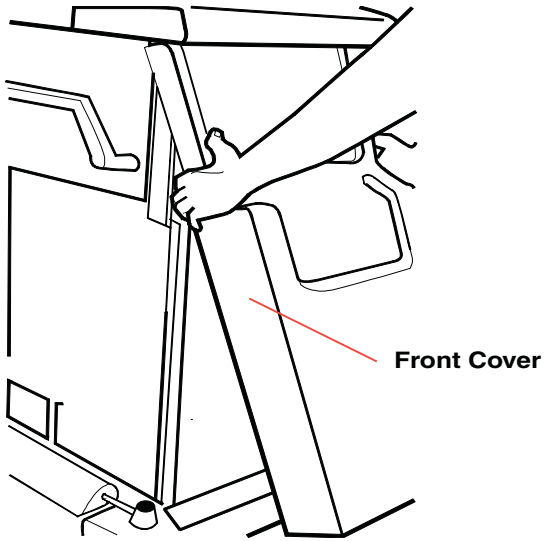


Side Cover Removal

Front Cover Removal

***Note**: Rear cover and side covers must be removed before front cover can be removed*

1. Using both hands, grasp front cover near bottom of cover.
2. Giving equal pressure with both hands, lift front cover upward to disengage two ball-nut fasteners on bottom edge of cover.
3. Move front cover upward under keyboard.
4. Move front cover outward, then downward to free it from Workstation.

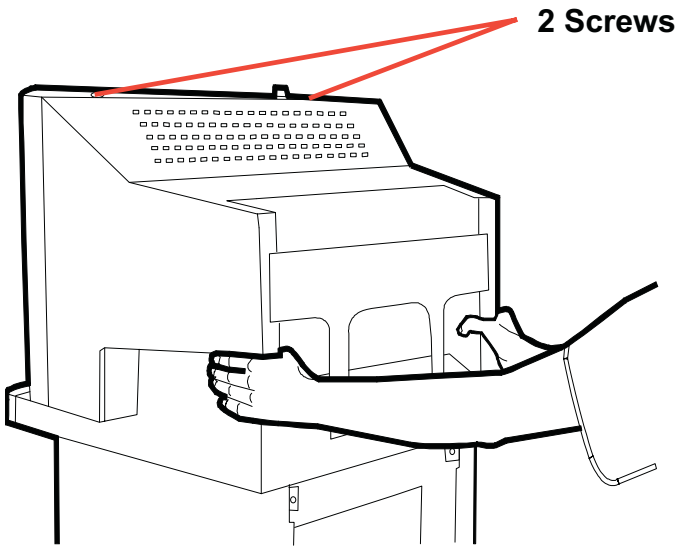


Front Cover Removal

Monitor Cover Removal

***Note**: Ball-nut fasteners hold bottom of monitor cover to front of monitor chassis.*

1. Remove two torx screws at top of cover.
2. Grasp monitor cover with both hands.
2. Pull monitor cover away from Workstation to free ball-nut fasteners from front of monitor chassis.

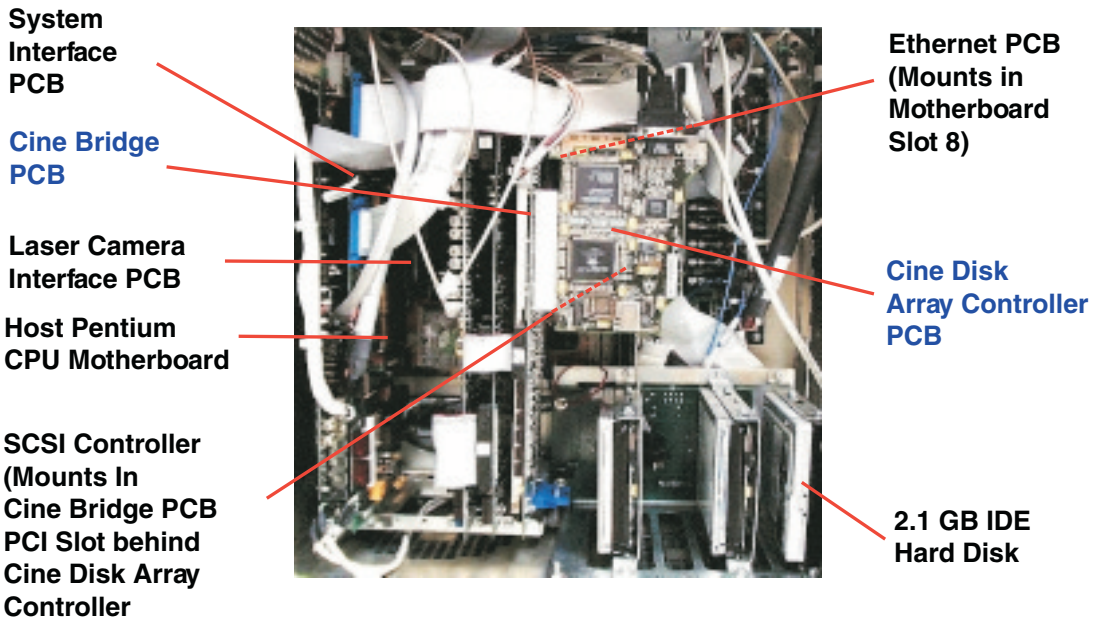


Monitor Cover Removal

Host Controller

The following is a basic description of Host Controller hardware. Refer to **Section 4 - Host Controller** for detailed circuit descriptions, troubleshooting information, and component replacement instructions.

The Host Controller manages image acquisition, image processing, image display and annotation, image storage, and user communications. Host Controller circuitry consists of a high-performance Host Pentium CPU motherboard, System Interface PCB, SCSI Controller PCB, Ethernet® (DICOM) Interface, Laser Camera Interface, IDE Hard Disk Drive, and 3.5-inch floppy disk drive. These devices reside in the Electronics box, located near the base of the Workstation.


System Interface PCB
Cine Bridge PCB
Laser Camera Interface PCB
Host Pentium CPU Motherboard
SCSI Controller (Mounts In Cine Bridge PCB PCI Slot behind Cine Disk Array Controller
Ethernet PCB (Mounts in Motherboard Slot 8)
Cine Disk Array Controller PCB
2.1 GB IDE Hard Disk

Host Controller Components in Electronics Box

Host Pentium CPU Motherboard

Nearly all Workstation functions are software controlled. The software executes in a multi-processor environment in the Host Pentium CPU, which communicates over the ARCNet bus to control the other intelligent devices in the Workstation and in the X-ray generator.

When the Workstation powers up, the Host Pentium CPU loads system or diagnostic software from a 1.44 Mb floppy disk mounted in the floppy disk drive located at the rear of the Workstation. If the floppy disk drive is empty (usually the case) the host Pentium CPU instead loads system software from the Workstation IDE hard disk drive. Following a successful boot-up with software loaded into memory, the motherboard begins various run-time chores such as initializing intelligent peripheral devices and processing user inputs.

The motherboard has four 16-bit ISA slots, three of which are used. These slots are usually populated with the System Interface PCB, optional Laser Camera Interface, and Video Controller PCB. The spare ISA bus slot is normally empty, but it can accommodate a VGA video card for diagnostic purposes.

There are four 32-bit PCI bus slots, all of which are used. These slots support the Display Controller PCB, Image Processor PCB, Cine Bridge or SCSI Controller, and Ethernet (DICOM) card.

Single Board Computer and Passive Backplane

Earlier versions of the Host Controller consisted of a standard Socket 7 motherboard equipped with conventional PCI and ISA slots that accommodated the peripherals.

The current version of the Host Controller consists of a **Passive Backplane** that supplies the PCI and ISA slots. A special slot on the Passive Backplane accommodates the **Single Board Computer** (SBC), which performs the same functions as the earlier motherboard, but is easier to troubleshoot and replace.

Please refer to **Section 4 - Host Controller** for more information.

System Interface PCB

The System Interface PCB resides in ISA bus slot 2 of the Host Pentium CPU motherboard. As its name implies, the System Interface PCB helps the Host Pentium Processor communicate with other system devices. Main features of the System Interface PCB include:

- An Option PROM that configures the Host Pentium Processor's BIOS for operation in the Workstation
- An ARCNet Controller and Interlock that enable the Host Pentium Processor to communicate with other intelligent PCBs in the Workstation and in the image generator
- Data bus buffers that develop rewind, fast forward, play, pause, and record signals for the optional video cassette recorder (VCR).
- Serial communication chips that enable the Host Pentium Processor to communicate with the modem, monitors (for setup and automatic contrast/brightness control), Control Panel PCB, and Touch Screen assembly

SCSI Controller PCB

The SCSI Controller PCB located in PCI Bus 0 slot 7 enables the Host Pentium Processor to communicate with several daisy-chained peripherals, including a removable media hard disk drive, CDROM drive, and magneto-optical drive. The principal advantage of using SCSI technology is that one interface can control up to seven devices.

When the Workstation is equipped with an optional Cine Disk subsystem, the SCSI controller PCB connects to the PCI Bus on the Cine Bridge PCB.

Ethernet (DICOM) Interface PCB

The optional 32-bit Ethernet adapter PCB resides in PCI Bus 0 slot 8. The PCB allows the Workstation to transmit images over a local DICOM network. The card can communicate at up to 132 Mb/s with the Pentium PCI motherboard, and at 100 Mb/s over the network.

VGA Video Card

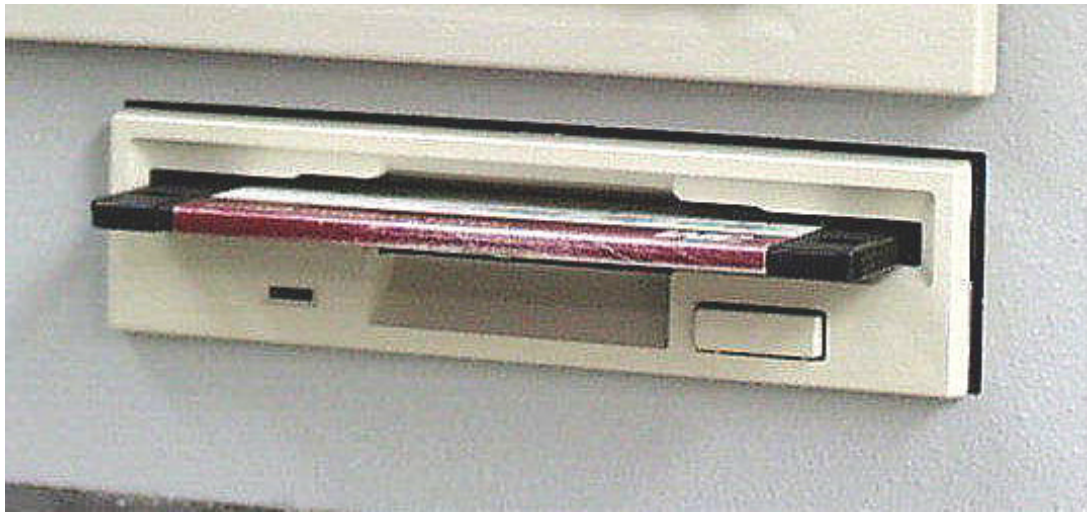
ISA Bus Slot 4 in the Host Pentium CPU motherboard is normally vacant and unused. It can, however, accommodate a VGA video card that may be used for diagnostic purposes.

IDE Hard Disk Drive

The Workstation normally boots from the 50-megabyte non-DOS partition of this 4.3-Gigabyte drive, which contains the Nucleus® operating system and OEC application software. This drive also has a DOS-readable partition that is available to the user for image and data storage. The IDE hard disk drive is located in the bottom right-hand corner of the Electronics box.

Floppy Disk Drive

The 3.5-Inch, 1.44-megabyte floppy disk drive, located on the Workstation rear panel at the rear of the Electronics box, serves as an alternate boot drive; it can also store single images on standard 3.5-inch floppy disks.



3.5-Inch, 1.44-Megabyte Floppy Disk Drive on Workstation Rear Panel

Display Subsystem

The following is a basic description of the Display Subsystem hardware. Refer to **Section 5 - High Resolution Displays** for detailed circuit descriptions, troubleshooting information, and component replacement instructions.

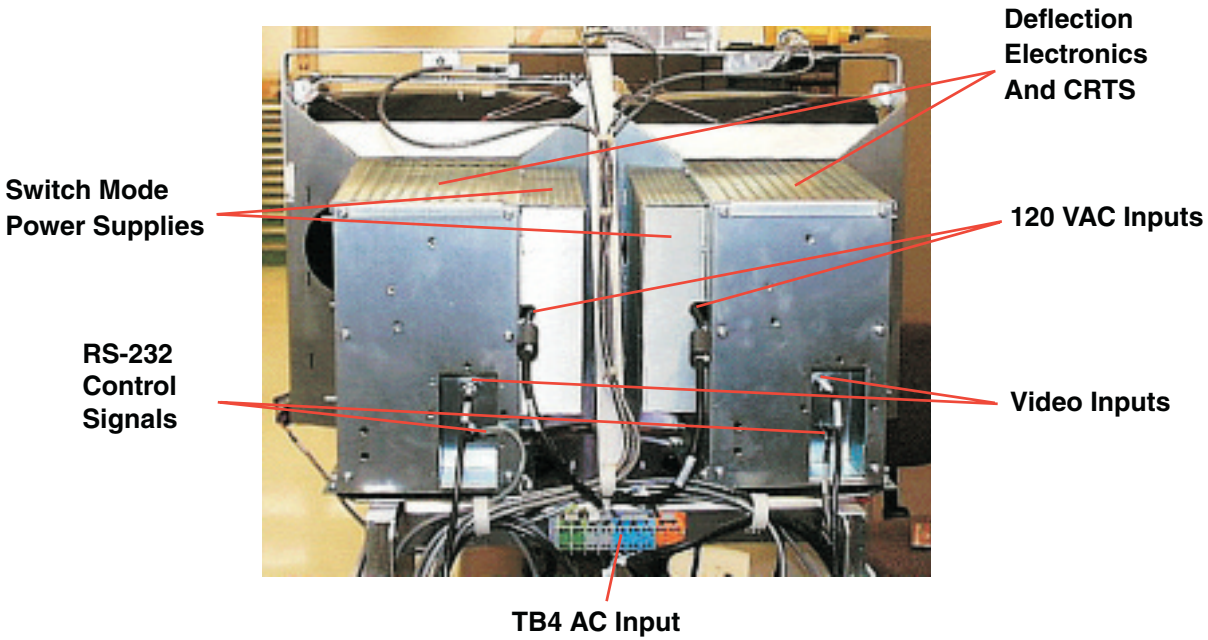
The Display Subsystem consists of two 16-inch, high resolution, high contrast, high brightness, monochrome monitors. Each monitor can display up to 1030 lines per frame with 1320 pixels per line maximum. The left-hand monitor is called the Primary display because it shows newly acquired images. The right-hand monitor is called the Secondary display; it shows acquired images and provides a mounting place for a Touch Screen assembly that you can use with a CRT-displayed graphical user interface to control many system functions.

The monitor frame serves as the mounting point for the **X-Ray On indicator**, **infrared remote sensors**, **ambient light sensor**, and the lighted **ON/OFF pushbutton**, which are described elsewhere in this section.

High Resolution Displays

The following illustration shows a rear view of the two Workstation monitors. Both monitors are electrically identical; each is powered by 120 VAC from TB4, and each receives its video drive signal from the Display Controller PCB. The System Interface PCB supplies control signals from the Host CPU to the monitors. These RS-232 signals control image contrast and brightness, and setup parameters such as vertical size and raster centering.

Mechanically, the Primary and Secondary displays are approximate mirror images of each other. The larger cage on each monitor holds the CRT, deflection electronics, and video circuits. The smaller cage holds the switch mode power supply.

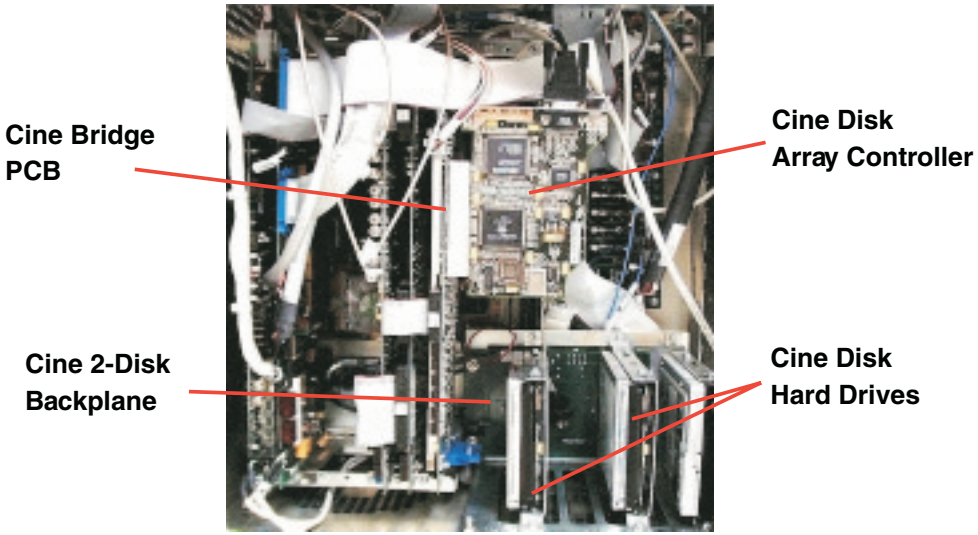


High Resolution Displays - Rear View

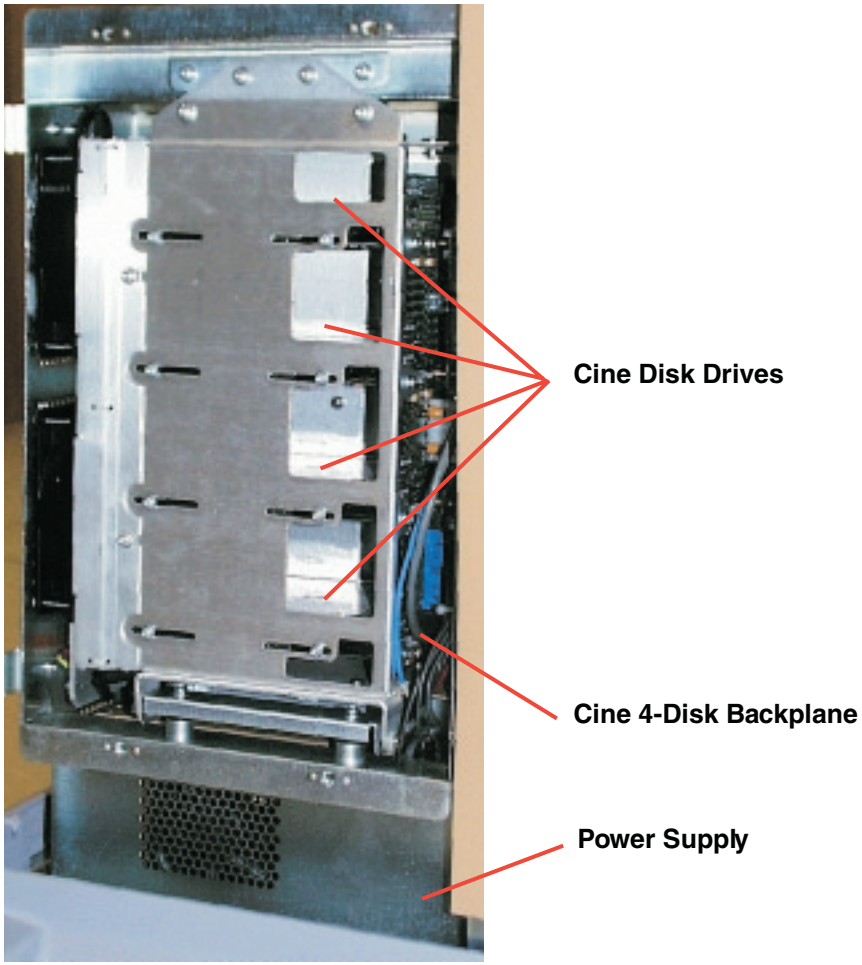
Cine Disk Subsystem

The following is a basic description of the Cine Disk hardware. Refer to **Section 6 - Cine Disk Subsystem** for detailed circuit descriptions, troubleshooting information, and component replacement instructions.

The optional Cine Disk Subsystem allows the Workstation to capture digitized X-Ray images from its Image Subsystem at 15 FPS or 30 FPS (12.5 and 25 FPS at 50 Hz). The Cine Disk Subsystem consists of the Cine Bridge PCB, which mates with a PCI bus slot on the Host Pentium CPU, a Cine Disk array controller that resides on the Cine Bridge PCB or plugs into one of the PCI 1 bus slots on the Cine Bridge PCB, one or two Cine Disk Backplane PCBs, and up to six hard disk drives. The larger four-disk backplane resides in a separate Cine Disk assembly with its own power supply near the Electronics box. The two-disk backplane and associated hard drives mount inside the Electronics box.



Cine Disk Components in Electronics Box



Cine Four-Disk Assembly (Covers Removed)

Cine Bridge PCB

The main purpose of the Cine Bridge PCB is to generate another PCI bus (PCI Bus 1) that is separate but linked to the Host Pentium CPU's PCI Bus (PCI Bus 0). Although the Host Pentium CPU maintains control of PCI Bus 1, it is actually a reserved, high-capacity data path between frame memory on the Cine Bridge PCB and the Cine Disk array. Having a separate PCI bus enables the Host Pentium CPU to maintain its full PCI bandwidth while images transfer at required speed to and from the Cine Disk drives.

The Cine Bridge PCB accepts X-Ray image data from the Image Processor as 10-bits-per-pixel parallel data. During image acquire mode, the Cine Bridge PCB packs three pixels into a single 32-bit word and stores the packed image in one of three frame buffers. During image playback, frame data from the disk drives fill one buffer while a pixel packer unpacks a different buffer. The Cine Bridge PCB returns image data to the Image Processor in the 10-bit-per-pixel parallel format.

Cine Disk Array Controller

The cine disk array controller is also known as the Fibre Channel Arbitrated Loop (FC-AL) Disk Controller. It provides the data interface between the Cine Bridge PCB and the cine disk drives. The controller's job is to exchange image data with the frame buffers on the Cine Bridge PCB and the Cine Disk drives.

The FC-AL serial data loop daisy-chains to each drive, starting at the controller and returning there after passing through the backplanes. Loop data leaves the controller on fibre channel cable and arrives at the Two-Disk Backplane, where it enters the first disk drive and then the second disk drive on the backplane. The output of the Two-Disk Backplane feeds the input of the Four-Disk Backplane, again on fibre channel cable. After passing serially through each drive on the Four-Disk Backplane, the 1.063 Gb/s loop data returns to the controller, once more on fibre channel cable.

CAUTION: *Fibre channel cable is very fragile. If the foam core supporting either conductor is kinked or pinched, an impedance "bump" occurs at that point, attenuating the high rate FC-AL signal and sometimes causing data loss. Never compress a fibre channel cable or bend it with a radius of less than 0.5 inches.*

Cine Disk Backplanes

Each Cine Disk Backplane performs several functions:

- Provides power to each disk drive
- Provides looping input and output FC-AL fibre channel connectors
- Provides loop resiliency circuits (LRCs) that detect whether drives are plugged in and route the FC-AL signal past missing or inoperative drives

Cine Hard Disk Drives

The Cine Disk drives are much like standard SCSI drives, except that they contain circuitry that unpacketizes incoming commands and data into normal SCSI format, and packetizes outgoing SCSI data for transmission over the FC-AL loop.

Image Subsystem

The following is a basic description of the Image Subsystem hardware. Refer to **Section 7 - Image Subsystem** for detailed circuit descriptions, troubleshooting information, and component replacement instructions.

The Image Subsystem processes video from the CCD camera to produce enhanced images for the Display system monitors and Cine Disk subsystem. The Image Subsystem also produces standard resolution interlaced video for the optional VCR, and digitized images for the DICOM interface, optional laser camera, and optional hardcopy devices. The Image Subsystem includes the Video Controller PCB, Image Processor PCB, and Display Adapter PCB, all of which are located in the Workstation's Electronics box.

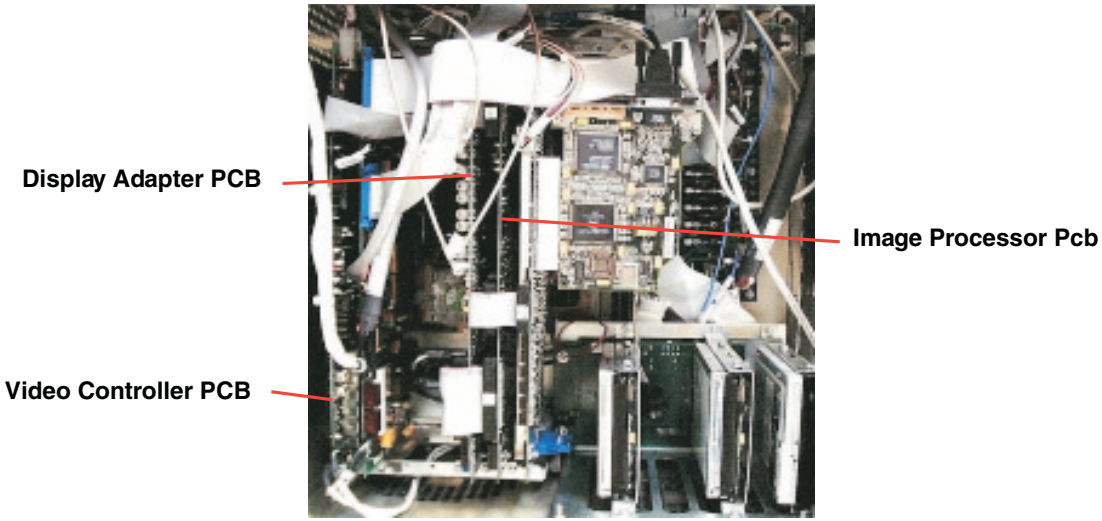


Image Subsystem Components in Electronics Box

Video Controller

The Video Controller accepts analog differential video and pilot tone (sync) signals from the CCD camera. The pilot tone signal contains sync, drive, and pixel clock data. The Video Controller converts the analog video signal to ten bits per pixel parallel data, which it sends to the Image Processor.

The Video Controller performs Genlock control for the Workstation, anti-aliasing and anti-vignetting of the digital X-Ray images, and creates the VLI window needed for the X-Ray Generator to perform Automatic Brightness Stabilization.

Image Processor

As its name implies, the Image Processor manipulates the digital video from the Video Controller to produce the following effects and functions in the displayed images:

- Vertical and horizontal image reversal
- Circular blanking
- Window and level control
- Automatic sample window positioning
- Real-time image edge enhancement
- Subtraction
- Peak opacification
- Zoom and roam
- Cine interface generation
- Text and graphics for image annotation

Display Adapter

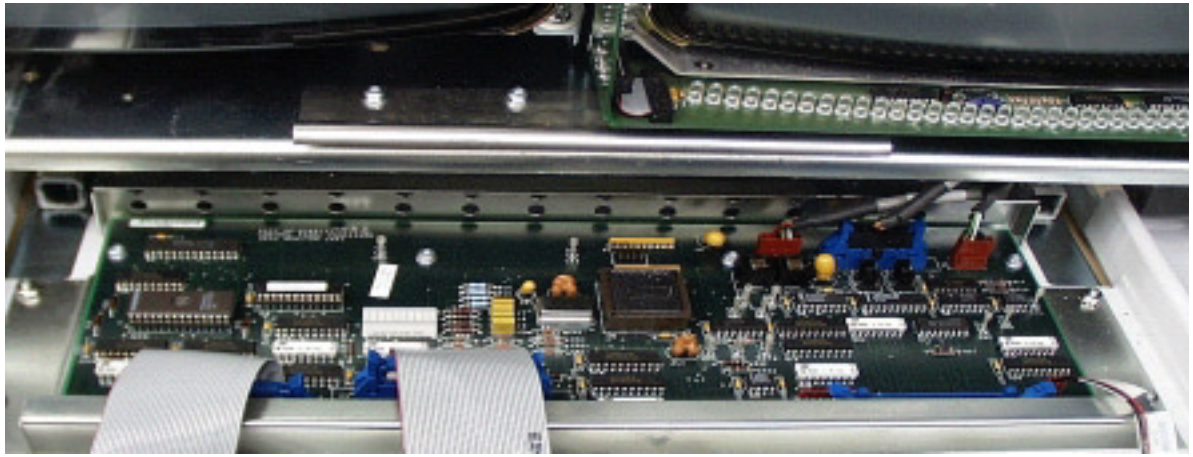
The Display Adapter PCB translates the 25 or 30 FPS 1024 x 1024 pixel images generated in the Image Processor to 60 or 75 FPS non-interlaced video for output to the high-resolution display monitors. The Display Adapter also converts the non-interlaced Image Processor video to standard resolution interlaced video that is compatible with PAL or NTSC video cassette recorders and monitors.

User Interfaces

The Workstation's user interface includes the Control Panel Processor (a PCB that mounts below the Keyboard), Keyboard, Infrared Receiver and Handheld Transmitter, Touch Screen, XRAY ON indicator, and ON/OFF pushbutton. Refer to **Section 8 - User Interface** for detailed circuit descriptions, troubleshooting information, and component replacement instructions.

Control Panel Processor

The Control Panel Processor (CPP) scans for key closures on the Keyboard and reports these closures to the System Interface PCB in the Host Controller subsystem for further processing. The CPP also responds to commands from the System Interface PCB to light Keyboard LEDs.



Control Panel Processor

Keyboard

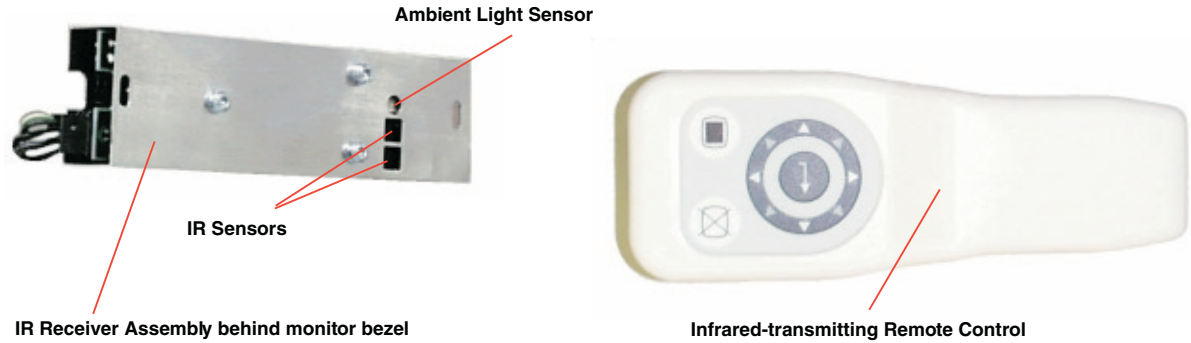
The operator uses the keyboard to enter patient annotation information and control system operation. The keyboard has a standard QWERTY alphanumeric key array, plus several special-purpose keys. It is covered by a flexible membrane designed to resist liquids and other contaminants, and is replaceable (but not repairable) in the field. The keyboard PCB has no active circuitry; its keys are scanned by the Control Panel Processor, which also drives the LEDs on the keyboard PCB.

Keyboard

Infrared Remote

The optional infrared (IR) remote system consists of a battery-operated, hand-held IR transmitter, and an IR receiver that mounts between the two Workstation monitors behind the bezel. You can use the hand-held transmitter up to 20 feet from the Workstation to access most system functions. When you press a button on the hand-held IR transmitter, the transmitter generates a pulsed waveform and converts it to invisible infrared light, much like a standard television remote control. The IR receiver assembly in the Workstation detects the IR beam from the transmitter, converts the pulsed infrared light back to an electronic signal, and passes the signal to the Control Panel Processor for decoding and processing.

The ambient light sensor is part of the high-resolution **Display Subsystem**. It senses room lighting conditions, enabling the display subsystem to maintain proper monitor brightness.

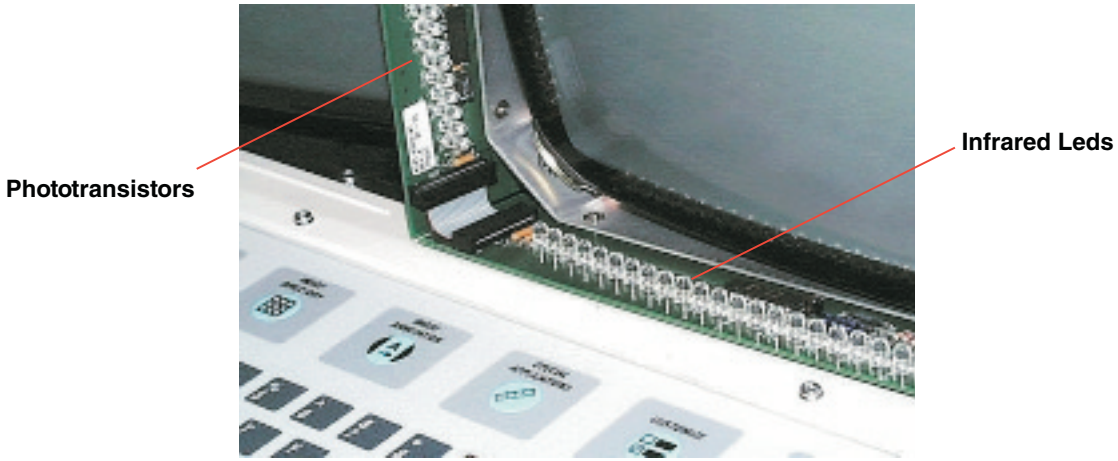


IR Receiver and Hand-held Remote Control

Touch Screen

The Secondary system display (i.e., the right-hand monitor) is equipped with an array of infrared light-emitting diodes and a corresponding array of phototransistors that detects the presence and calculates the location of a finger touched to the CRT. You use this touch screen feature in conjunction with displayed software screens to make mode and function selections during Workstation operation.

The LEDs and phototransistors are arranged in a rectangular matrix on a touch frame that surrounds the edge of the CRT. These devices are ordinarily invisible behind the monitor bezel. The touch frame has 43 LEDs on the right-hand edge, 43 LEDs on the bottom edge, 43 phototransistors on the top edge, and 43 phototransistors on the left-hand edge. A simple controller associated with the touch screen scans each phototransistor several times a second to detect beam interruptions, determines the x and y coordinates for the beam interruption, and transmits that information via RS-232 interface to the System Interface PCB for further processing.



Touch Screen Assembly

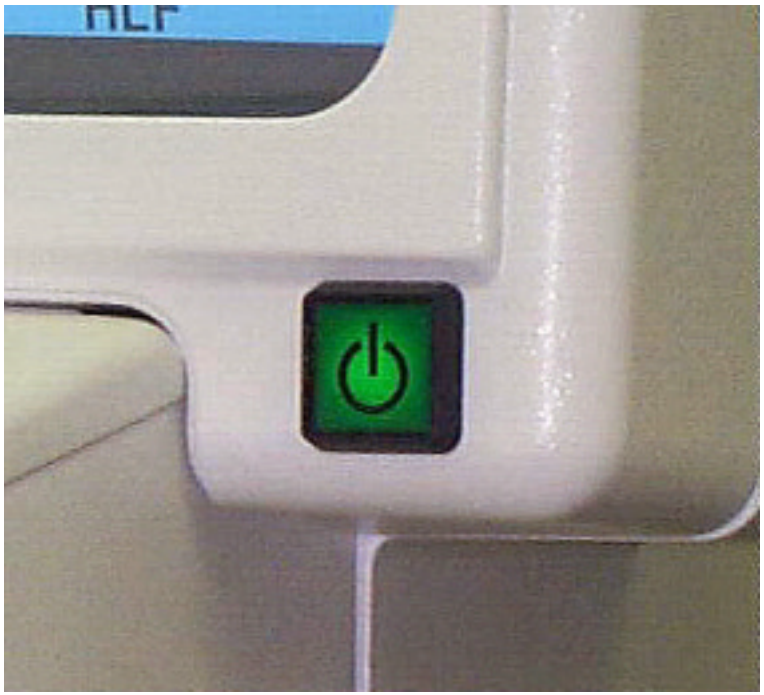
X-RAY ON Indicator

The X-RAY ON indicator lights at any time the system generates X-rays. Located on the top of the left-hand monitor, the indicator contains an array of six LEDs driven by a signal from the System Interface PCB.

X-Ray On Indicator

Lighted ON/OFF Pushbutton

The lighted SPST ON/OFF pushbutton controls application of AC power to the Workstation. The switch's 12-volt incandescent bulb lights when the Workstation is on.



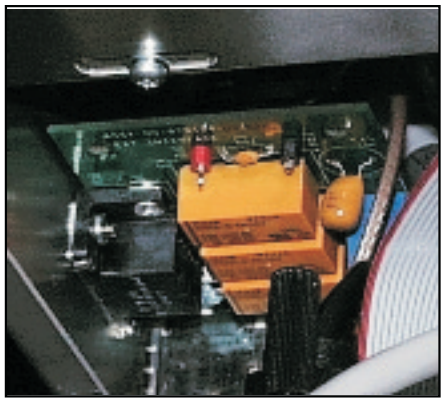
ON/OFF Pushbutton

External Interfaces

This paragraph discusses the External Interface PCB and Workstation rear panel. Refer to **Section 9 - External Interfaces** for detailed circuit descriptions, troubleshooting information, and component replacement instructions.

External Interface PCB

The External Interface PCB connects via ribbon cable to the System Interface PCB, which connects to ISA slot 2 on the Host Pentium CPU motherboard located in the **Electronics box**. As its name implies, the External Interface PCB connects the motherboard to the outside world. It provides DC isolation where necessary and adapts system signals to make them compatible with external equipment connected to the Workstation rear panel and Interconnect cable. In some cases, the External Interface PCB passes signals straight through without modification. In other cases it adds a simple pullup resistor or current-limiting resistor to a signal line. In other cases, the External Interface PCB uses an ISA bus signal to switch relay contacts. The External Interface PCB mounts directly behind the Workstation rear panel as shown below.



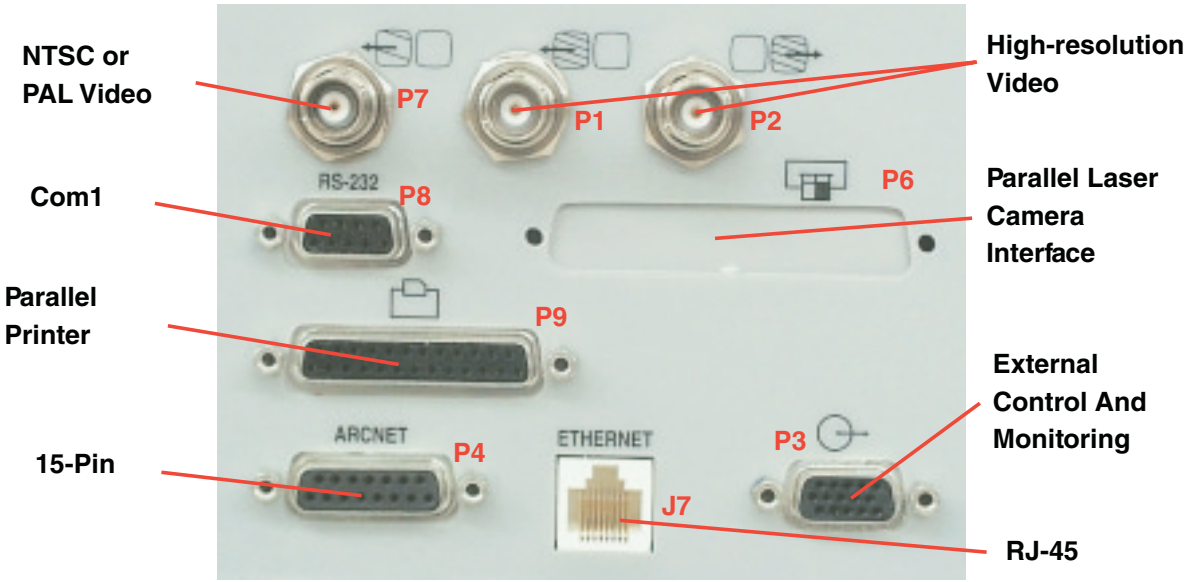
View inside electronics box directly behind rear panel connectors

External Interface PCB

Rear Panel Connectors

The following illustration shows the Workstation rear panel connectors.

Not all interfaces present on the Workstation rear panel pass through the External Interface PCB. For example, COM1 and LPT1 connect directly to the Host Pentium CPU, and the video signals come directly from the Display Controller.



Workstation Rear Panel Connectors

Power Distribution Subsystem

The Workstation Power Subsystem distributes AC and DC power to Workstation components, and may also provide AC power to externally attached equipment such as a C-Arm. Power Subsystem components include the power plug and cord, Surge Suppressor PCB, Isolation Transformer, AC circuit breakers, Power Control PCB, terminal blocks, AC line filter, cooling fans, and DC power supplies PS1 and PS2. These components are located throughout the Workstation. Refer to **Section 3 - System Power Distribution** for additional information.

System Software

System software that controls both the Workstation and the X-Ray generator resides on the Workstation's IDE Hard Disk Drive. The Workstation Host Controller subsystem normally boots from this drive.

OEC application software executes under the Nucleus® operating system. The OEC applications and operating system are both located in the non-DOS formatted 50 Mb portion of the hard drive.

File management and related utilities are located on the DOS-formatted section of the hard drive.

Boot Sequence

When you power up the Workstation, Host CPU software begins a step-by-step process of conducting power-on self tests (POSTs), establishing ARCnet interprocessor communications, and performing other tasks that prepare the system for use. This series of events is called the boot sequence. For a detailed description of the steps included in the boot sequence, refer to **Section 10 - Software**.

Status and Error Codes

If an error occurs during the boot-up process, an error message appears on the right-hand display. Refer to **Section 10 - Software** for a complete description of each status and error code.

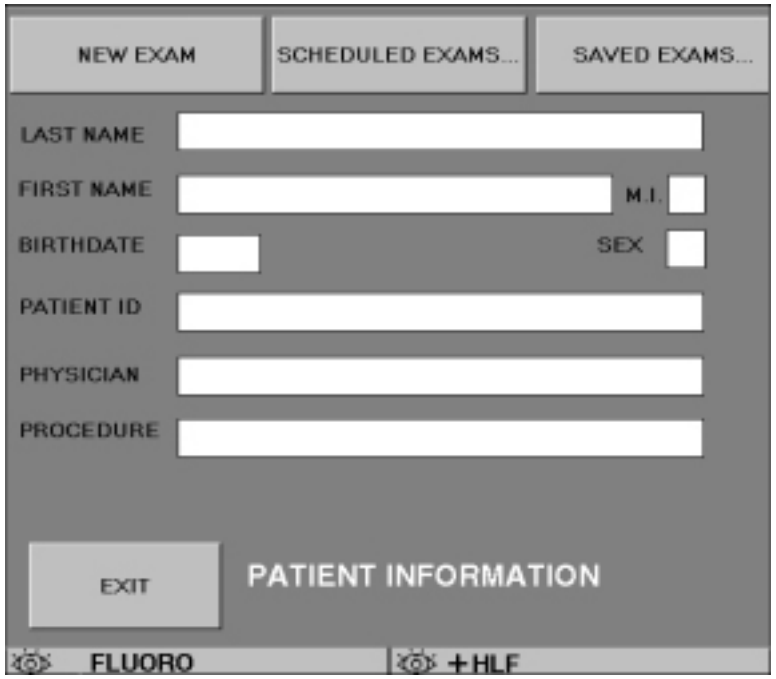
Run-time Error Reporting

Errors that occur during Workstation operation generate a message on the right-hand display and cause the Workstation software to cease operation. Run-time errors include DOS errors, I/O errors, critical errors, and fatal errors. For a description of the run-time errors most likely to affect Workstation operation, refer to **Section 10 - Software**.

Touch Screen Graphical Interface

Workstation software includes a comprehensive graphical user interface (GUI) that works with the **Touch Screen** hardware described above to allow you to select modes and features by touching a finger to the right-hand display screen.

The Patient Information screen, shown below, appears automatically after a successful Workstation boot-up.



Patient Information Screen

The Patient Information screen gives you four choices:

1. Touch **NEW EXAM** to enter information for a new patient.
2. Touch **SCHEDULED EXAMS** to display a list of patients who have not yet been examined.
3. Touch **SAVED EXAMS** to display a list of patients for whom images have been stored.
4. Touch **EXIT** to go to the Main Image screen

Each of the above choices displays another unique touch screen that requires further operator input. Nearly all system functions are available through the touch screen interface.

Please refer to the **OEC Workstation Operator's Guide** for complete information on how to use the Touch Screen interface. This is a paper document supplied with the Workstation.

Setup Utilities

The Host CPU motherboard has flash ROM BIOS that is preconfigured by OEC at the factory for the specific equipment and options supplied with each Workstation. When you add or replace Workstation equipment, follow the instructions you receive from the factory to update the BIOS.

Service Port

The ARCNET connector on the Workstation rear panel is a secure serial port reserved for customer technical personnel or OEC Field Service Engineers. It is used to configure, test and calibrate both the Workstation and X-Ray generator.

The service port uses a packet-based handshaking protocol to communicate with a remote computer. Usually the remote computer will be a laptop located a few feet away from the Workstation.

The remote computer becomes the server, downloading command and data packets to the Workstation client. The Workstation responds with an ACK when it successfully receives a packet, and with a NAK if it doesn't receive a complete packet within the timeout period. The remote computer resends the packet until it receives an ACK from the Workstation, and then sends the next packet. An upload from the client (the Workstation) consists of much the same protocol in reverse; the Workstation sends a packet, which the remote computer responds to with an ACK or NAK. In the event of a NAK, the Workstation resends the packet until its service port times out. A timeout of the service port terminates the remote session.

Refer to **Section 9 - External Interfaces** for complete hardware information on the Workstation's service port.

Remote Utilities

The Remote Utilities Software (RUT) is a suite of programs that execute on a remote computer, which communicates with the Workstation service port just described. RUT allows customer technical personnel and OEC Field Service Engineers access to the system for the following purposes:

- Setup
- Configuration
- Calibration
- Troubleshooting

Please refer to **Section 10 - Software** for additional details on the Remote Utilities.

Modes of Operation

The following paragraphs describe the six basic modes of operation for the OEC Workstation, including Fluoro, High-Level Fluoro, Digital Spot, Subtract, Roadmap, and Film. Only basic descriptions of these modes will be given here. For a complete description of how to enter and use each mode, refer to the **OEC Mobile Workstation Operator's Guide.** This is a paper manual that ships with the Workstation.

Fluoro

During Fluoro (fluoroscopic) mode, the Workstation displays live X-Ray images on the left-hand monitor (also known as the Primary Display). Technique (kVp and mA) control can be manual or automatic. A fluoro shot terminates and image acquisition ceases when the operator releases the X-Ray switch.

High-Level Fluoro

During High-Level Fluoro (HLF), fluoroscopic mA increases to reduce noise and improve image quality. The Workstation displays live X-Ray images on the left-hand monitor (Primary Display). Technique control (kVp and mA) can be manual or automatic. A high-level fluoro shot terminates and image acquisition ceases when the operator releases the X-Ray switch, or when the length of the exposure reaches a preset amount of time (20 seconds maximum).

Digital Spot

The Digital Spot mode creates short-duration HLF images to visualize dense anatomy. The Workstation automatically saves the image to the hard disk after each exposure. After you save the image to disk, you can apply image enhancements such as Noise Reduction, Sharpen, or Contrast/Brightness.

Subtract

Subtraction produces images that are the difference between a fluoroscopic image obtained while contrast media is present in a vessel and a mask image of the same anatomy obtained just prior to the subtraction process before injection of the contrast media. The subtracted image appears on the left-hand monitor. Subtraction is ideal for visualizing vasculature.

Roadmap

Roadmapping produces a series of subtracted images that are the difference between a fluoroscopic image obtained with a catheter present in a vessel, and a mask image obtained just prior to catheter insertion when a peak level of contrast media is present in the vessel. Roadmap images appear on the left-hand monitor. Because they clearly show catheter movement, Roadmap images are very useful in precise catheter placement.

Film

The Film mode automatically produces the correct technique to expose radiographic film.

Configurations

The Workstation is available in five basic configurations: Enhanced Surgical Platform (ESP), Enhanced Surgical Platform - Cine, Vascular, Neurovascular, and Cardiac.

Enhanced Surgical Platform

The Enhanced Surgical Platform (ESP) is the basic Workstation configuration around which the other Workstation configurations are built. The ESP includes the following features:

- Standardized, sealed keyboard
- Touch screen graphical user interface (GUI)
- Expanded external interface capabilities
- DICOM interface

When all options are installed, the ESP has the following capabilities:

- On-line help screens for system functions and features
- Image annotation
- Image directory that allows image selection by doctor, patient, or date
- Display of X-Ray dose information that includes shot type, date, time, mode, DAP, cumulative DAP, and technique
- Dose Log option that displays DAP, cumulative DAP, and modes used. Dose measurement may be set to microgray or rad
- Access special applications such as vessel measurement software
- Test pattern screen
- Customization screen for Auto Save and other functions

- Entry of date and time
- A VCR interface that allows images to be recorded to and played back from S-VHS cassette tape
- Zoom in and roam a region of interest on recorded images.
- Provide edge enhancement on LMON images
- Apply variable sharpening on static and real-time images
- Reverse image grayscale to represent a film negative
- Provide autohistogram image equalization
- Provide automatic and manual brightness and contrast control
- Provide mode selection interface to X-Ray generator that allows selection of fluoro and digital spot modes
- Apply noise filter (recursive averaging) to 2, 4, 8, or 16 frames
- Save any LMON image to hard disk
- Swap images between monitors
- Control cursor movement and mode selection with keyboard, touch screen GUI, or IR remote

Enhanced Surgical Platform -- Cine

This Workstation configuration includes the features and capabilities of the ESP Workstation described above, plus the ability to record images at 15 FPS (12.5 FPS at 50 Hz) for up to 5 minutes. The ESP has no digital subtraction or roadmapping capability.

Vascular

The Vascular Workstation has the same features as the ESP - Cine Workstation described above, plus the ability to perform digital subtraction and roadmapping. The Vascular Workstation also offers the Landmark feature that displays a variable percentage of background in a subtracted image, Mask Registration to realign a mask with a subtracted image, and Peak Opacification to improve the contrast of a subtracted image.

Neurovascular

The Neurovascular Workstation is similar to the Vascular Workstation, except that it has 30 FPS, 5-minute Cine capability. High-Level fluoro and the 30 PPS option are not available. The removable zip disk is an option.

Cardiac

The Cardiac Workstation offers 30 FPS, 5 minute Cine Disk capability, High-Level fluoro, and the removable zip disk as standard features. The 30 PPS option is also available in the Cardiac Workstation.

Options

The following optional equipment is available for the OEC Workstation.

Cine Disk

The Digital Cine option offers high technique levels for imaging small vessels and other anatomy that is in constant movement. The 15 FPS option stores high resolution images at up to 15 images per second (12.5 FPS at 50 Hz) for up to five minutes. The 30 FPS option stores images at up to 30 images per second (25 FPS at 50 Hz) for up to five minutes.

For more information, refer to **CINE DISK SUBSYSTEM**, which appears earlier in this section, or to **Section 6 - Cine Disk Subsystem**.

Measurement Software

This optional software feature allows a doctor to make linear or angular measurements of vessels, bones, and other anatomy. It is especially useful in orthopaedic and cardiac applications. For additional information the measurement software, refer to **Section 10 - Software**

Infrared Remote

The optional handheld infrared remote control is described and illustrated under **USER INTERFACES,** which appears earlier in this section. The infrared remote is available for all Workstation configurations.

Video Cassette Recorder

The VCR option includes a remotely-controlled, half-inch S-VHS tape machine and the power, control, and signal cables necessary to install the VCR in the Workstation. The VCR accepts down-scanned video from the Display Controller PCB in NTSC (RS-170) or PAL (CCIR) format. Although the VCR cannot record 1kx1k high resolution images, it offers much greater image storage capacity than a cine disk (two hours or more compared to five minutes maximum).

For a complete description of the VCR's video and control interfaces, refer to **Section 7 - Image Subsystem**

Video Cassette Recorder

SCSI Devices

The SCSI Controller PCB described previously in the **HOST CONTROLLER** paragraphs supports several optional devices, such as a removable media hard disk drive. The SCSI controller can support up to seven SCSI devices.

Removable Dynamic Digital Disk

The removable disk drive, located on the Workstation rear panel, is supplied as a standard feature on Cardiac Workstations, and is available as an option on others. The removable cartridge can hold about two gigabytes of data. The fast transfer rate and large storage capacity make it ideal for archiving cine runs.

Removable Media Hard Disk Drive

Hardcopy Camera

The hardcopy camera prints archived images on standard 8 x 10 inch X-Ray sheet film. It accepts IEEE 1284 compliant digital video from the Display Controller on a 25-pin D-type connector. It prints one or two images on each film sheet under program control.

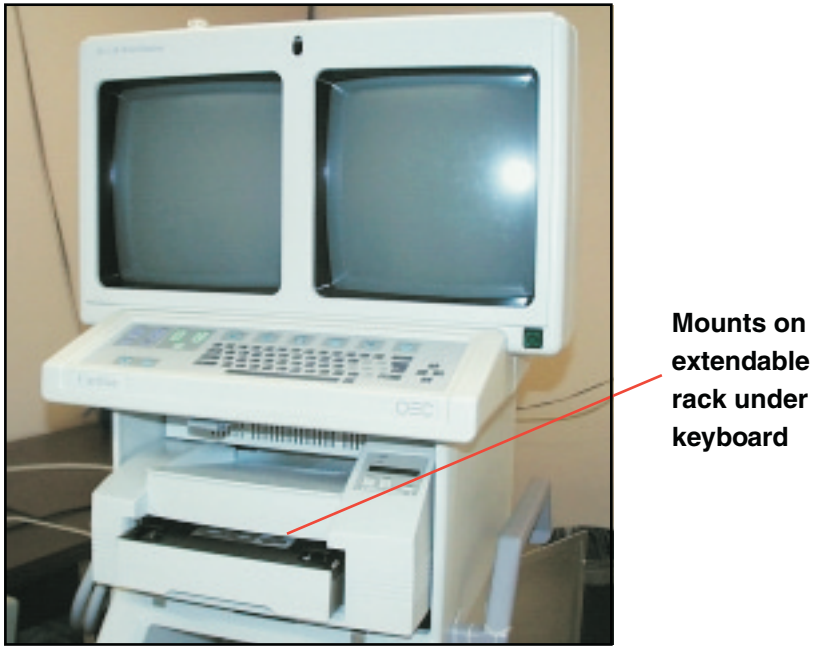
For complete information on the hardcopy camera interface, refer to **Section 7 - Image Subsystem**.

Hardcopy Camera

Instant Film/Paper Printer

The Instant Film/Paper Printer is a hardcopy output device that prints archived images on paper or transparency film at 300 dpi. The printer outputs 256 levels of grey. The printer accepts Centronics-compatible data from the Display controller on a 36-pin connector, and operates under program or front panel control.

For complete information on the Instant Film/Paper Printer interface, refer to **Section 7 - Image Subsystem**.



Instant Film/Paper Printer

Laser Camera Interface

The laser camera interface is an 8-bit ISA PCB that mounts in ISA slot 3 of the Host Pentium CPU motherboard. Under program control, this PCB transmits digital archived images over a 37-pin D-type connector to a remote laser imaging camera connected to the Workstation rear panel. The laser camera interface supports both the 3M MMU910 and Kodak Model 100 digital interface protocols.

For complete information on the laser camera interface, refer to **Section 7 - Image Subsystem**.

Laser Camera Interface

Thermal Printer

The thermal printer is a hardcopy device that accepts composite video (RS-170 or CCIR) from the Display Controller PCB to produce grayscale images on heat-sensitive paper. Image resolution is typically 256 scales of gray, with 1280 dots per line. The thermal printer requires manual control from a footswitch, remote control unit, or front panel controls. It can print a page in 10 seconds.

For a complete description of the composite video signals produced by the Display Controller, refer to **Section 7 - Image Subsystem**.

Typical Thermal Printer